Superparamagnetic nanoparticles for the local drug release and magnetic hyperthermia

Paulina PIETRZYK-THEL, Magdalena OSIAL, Michael GIERSIG

Institute of Fundamental Technological Research, Polish Academy of Sciences, Pawińskiego 5B 02-106 Warsaw,
ppietrz@ippt.pan.pl, mosial@ippt.pan.pl, mgiersig@ippt.pan.pl

SPIONs, Nanocomposite, Drug delivery, Anticancer treatment

Over the past 20 years, there has been a dramatic increase in the incidence of various cancers. The increased detection of various malignancies and their effective treatment requires the search for new approaches in anti-cancer therapy. One option is the use of nanomaterials and nanocomposites based on them to form a platform for simultaneous imaging, such as by nuclear magnetic resonance, and treatment by local drug release and temperature elevation directly in tumor tissues [1].

Here, we present results on the colloidal suspension based on superparamagnetic iron-oxide-based nanoparticles and hydroxyapatites as the matrix for the local anticancer drug release. The studies were focused on the optimization of the synthesis experimental composition, characterization of obtained material, and stability in aqueous solutions like PBS to be used in magnetic hyperthermia to generate heat locally and enhance the drug delivery. Core-shell particles were synthesized using a two-step wet co-precipitation method and stabilized with biocompatible organic molecules to produce stable colloidal suspension [2,3]. The heat generation effectiveness was determined using magnetic hyperthermia (MH), where the conditions to reach therapeutic temperature of the suspension in the constant and pulsed amplitude of alternating magnetic field (AMF) were optimized.

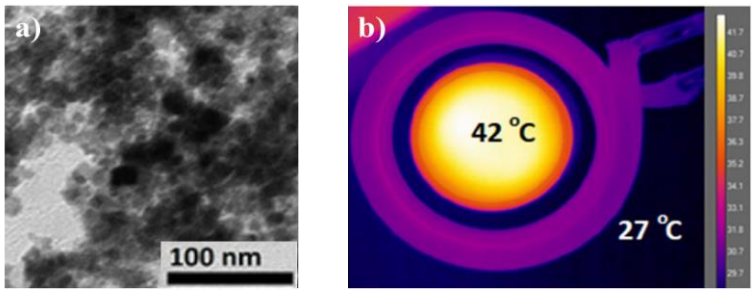

Figure 1. a) TEM image of prepared core-shell nanocomposite,
b) image from thermovision camera of suspension in AMF

References

[1] P. T. Nguyen, et al., "5-fluorouracil and curcuminoids extract from Curcuma longa L. loaded into nanohydroxyapatite as a drug delivery carrier for SKOV-3 and HepG2 cancer cells treatment" Ceramics International, pp. 1-13, 2023.
[2] M. Osial, et al., "Nanohydroxyapatite Loaded with 5-Fluorouracil and Calendula officinalis L. Plant Extract Rich in Myo-Inositols for Treatment of Ovarian Cancer Cells" Coatings, Vol.13, pp.1-21, 2023.
[3] M. Osial, et al,. "One-pot synthesis of magnetic hydroxyapatite (SPION/HAp) for 5-fuorouracil delivery and magnetic hyperthermia" Journal of Nanoparticle Research, Vol.26, pp.1-23, 2024.